Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740

www.exeloncorp.com

Exelon Nuclear

June 3, 2002

SVP-02-051

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Quad Cities Nuclear Power Station, Unit 2
Facility Operating License No. DPR-30
NRC Docket No. 50-265

Subject: Licensee Event Report 265/02-002, "Manual Scram due to Reactor Level Transient as a Result of a Digital Feedwater Level Control System Design Error"

Enclosed is Licensee Event Report (LER) 265/02-002, "Manual Scram due to Reactor Level Transient as a Result of a Digital Feedwater Level Control System Design Error," for Quad Cities Nuclear Power Station.

This report is submitted in accordance with the requirements of the Code of Federal Regulations, Title 10, Part 50.73(a)(2)(iv)(A), which requires reporting of any event or condition that resulted in manual or automatic actuation of the reactor protection system.

We are committing to the following actions:

The blown fuse indicator circuit will be removed from the 24 Vdc I/O signal fuse-holders (nine fuse holders for Analog input cards only) so the Digital Feedwater Level Control signal error detection function will work properly.

Proper fitting test equipment leads that will interface with the Rosemount transmitter hollow test screws will be investigated and obtained and the equipment will be insulated to minimize the potential of grounding an instrument loop on critical components in critical systems.

The default operator actions for feedwater level transients will be reviewed and any improvements identified will be implemented.

Any other actions described in the submittal represent intended or planned actions by Exelon Generation Company (EGC), LLC. They are described for the NRC's information and are not regulatory commitments.

IE22

Should you have any questions concerning this report, please contact Mr. W. J. Beck at (309) 227-2800.

Respectfully,

Timothy J. Tulon
Site Vice President
Quad Cities Nuclear Power Station

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station

NRC FORM 366 (7-2001) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Quad Cities Nuclear Power Station Unit 2	05000265	1 of 5

4. TITLE: Manual Scram due to Reactor Level Transient as a Result of a Digital Feedwater Level Control System Design Error

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									N/A	N/A
04	05	02	02	– 002 –	00	06	03	02	FACILITY NAME N/A	DOCKET NUMBER N/A

9. OPERATING MODE	1
10. POWER LEVEL	100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
20.2203(a)(1)	50.36(c)(1)(i)(A)	X 50.73(a)(2)(iv)(A)	73.71(a)(4)
20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	OTHER Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	
20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Wally Beck, Regulatory Assurance Manager	(309) 227-2800

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	JB	FVB	P482	Y					

14. SUPPLEMENTAL REPORT EXPECTED			15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X	NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On April 5, 2002, at 1028 hours, a manual scram was inserted on Unit 2 in response to increasing reactor level. The increase in reactor level was due to a blown fuse in the Digital Feedwater Level Control (DFWLC) system, caused by the inadvertent grounding of test leads during an instrument surveillance. Although the DFWLC logic is intended to be able to respond to a blown fuse without causing a level transient, the indicating fuse holder provided a circuit that inhibited recognition of the blown fuse by the DFWLC logic.

The root cause of the Unit 2 reactor scram was a design deficiency involving the installation of indicating fuse holders. The inadvertent grounding of the test leads was a contributing cause. Also, although the operator actions were in accordance with procedure, different actions may have mitigated this event.

The safety significance of this event was minimal. Adequate makeup to the vessel was available at all times from the feedwater system, as well as from the ECCS systems.

Corrective actions include removal of the indicating fuse holders, actions to minimize the potential for grounding test leads, and review of the default operator actions for a level transient.

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor, 2957 Megawatts Thermal Rated Core Power

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

EVENT IDENTIFICATION

Manual Scram due to Reactor Level Transient as a Result of a Digital Feedwater Level Control System Design Error

A. CONDITION PRIOR TO EVENT

Unit: 2 Event Date: April 5, 2002 Event Time: 1028 hours
Reactor Mode: 1 Mode Name: Power Operation Power Level: 100%

Power Operation (1) - Mode switch in the RUN position with average reactor coolant temperature at any temperature.

B. DESCRIPTION OF EVENT

During February and March of 2002, the new Digital Feedwater Level Control (DFWLC) [JB] system was added on Unit 2. On April 5, 2002, at 1000 hours, an Instrument Maintenance (IM) technician received authorization to perform instrument surveillance QCIS 0600-02, "Unit 2 Reactor Pressure 0 to 1200 psig Indication Calibration." The DFWLC control system was in the "three-element" mode of operation. The calibration activity involved two IM technicians in the field and one IM technician in the control room.

At 1023 hours, Pressure Transmitter [PT] 2-0647-A was placed in the "Calibrate Mode" at the Unit 2 DFWLC Operator Station to allow the IMs to proceed with the calibration. The "Calibrate Mode" is a designed feature of the DFWLC system that essentially disconnects the field device from the system logic and substitutes a constant input value. With the pressure transmitter disconnected, the calibration of the field device can continue without affecting the Reactor Pressure function of the system, unless the signal is disconnected or shorted.

At 1027 hours, a "hard failure" (signal error) was detected on the 2A Reactor Feed Pump (RFP) [P] [SJ] Suction Pressure Transmitter. This was later determined to be due to a blown fuse [FU] in an indicating fuse holder [FUB]. This type of signal error detected by the DFWLC system indicates that the transmitter loop current has dropped below 2.0 ma. A "hard failure" was NOT detected on the 2A RFP feedwater flow transmitter [FT] loop or 2A reactor pressure transmitter loop because the signal inputs to the DFWLC dropped to approximately 2.2 mA and 2.6 mA in the feedwater flow and reactor pressure loops, respectively.

Post-event testing confirmed that the loop currents do not decrease to zero milliamps when the fuse opens. The blown fuse should have resulted in an open circuit and loop currents less than 2.0 mA, which is the setpoint for the DFWLC systems sensing a "hard failure." However, a "sneak" circuit continues to supply

current from the 24 Vdc power supply through the indicating fuse holder. This type of fuse holder contains two light emitting diodes (LED's) and a 3.9K ohm resistor in parallel with the fuse. This unanticipated "sneak" circuit prevents proper operation of the DFWLC system. Specifically, the loss of the 2A RFP suction pressure does not immediately affect the operation of the DFWLC because two other redundant suction pressure signals are supplied as inputs into the system. Soft Majority Select (SMS) logic in the system discards the "bad" signal input and the DFWLC system begins to react to the low feedwater flow signal and the low reactor pressure signal when it is received.

AT 1028 hours, the DFWLC Event List indicated that "indicated" total feedwater flow had dropped below 90%. The drop in "indicated" total feedwater flow occurred simultaneously with the "hard failure" on the 2A RFP suction pressure transmitter. Prior to the event "indicated" total feedwater flow was 10.81 mlb/hr. After the loss of the 2A feedwater flow transmitter, "indicated" total feedwater flow spiked as low as 4.85 mlb/hr. Because the DFWLC system was in the three-element mode of operation, the apparent mismatch between steam flow and feedwater flow caused the 2A and 2B Feedwater Regulating Valve (FRV) [LCV] to open to 80% open (valve position is limited to 80% open). "Indicated" total feedwater flow increased to an estimated 6.64 mlb/hr. Because the 2A feedwater flow transmitter had failed, "real" total feedwater flow increased to 13.5 mlb/hr. The increased feedwater flow rate induced a vessel level increase.

Also at 1028 hours, the DFWLC Event List indicates feedwater pump suction pressure was less than 200 psig. The decreasing suction pressure was indicative of the feedwater flow increase. This initiated the control room annunciator for RFP low suction pressure. This was the first control room annunciator for this event. Almost simultaneously, the control room annunciator for Condensate Pump Low Pressure was received. The control room NSO began analyzing the panel annunciation and indication discrepancies and told the IM technicians to stop their activity.

At this time, RPV level was at 34 inches and increasing. The RPV High Level alarm was received in the control room. The 2A and 2B FRVs started closing from 80% open to 74% open position and decreasing. The NSO placed the 2A and 2B FRV manual/automatic (M/A) stations in the manual mode and started to manually close the FRVs. When reactor level continued to rise, the NSO manually scrammed the reactor due to reactor level reaching pre-established manual scram criteria. This caused reactor level to decrease, as normally occurs post-scram.

At approximately 1029 hours, a staggered trip of the 2C RFP occurred due to low RFP suction pressure. After the trip of the 2C RFP, suction pressure recovered to greater than 200 psig within three seconds. The sequential trip of the RFP on low suction pressure is a design feature of the DFWLC system.

Although DFWLC setpoint setdown occurred at this time (i.e., the level control setpoint was reduced to 15" as the reactor water level bottomed, turned and passed 15" during level recovery), because both 2A and 2B FRVs were in the manual mode, an adequate feedwater flow decrease did NOT occur and level continued to increase.

Following the automatic trip of the 2C RFP, the NSO manually tripped the 2A and 2B RFPs due to the level increase.

At 1033 hours, the IM technicians were notified that they could remove their test equipment and return the equipment to a safe condition. The technicians proceeded to remove the equipment and returned the transmitter to infield service.

At 1048 hours, the NSO manually started the 2B RFP. At 1100 hours, the reactor scram was reset.

C. CAUSE OF EVENT

The root cause of the Unit 2 reactor scram was a design deficiency involving the installation of indicating fuse holders. The fuse monitoring circuit provides a current source that prevents the DFWLC from receiving a signal failure when a fuse opens. The blown fuse indicator circuit in parallel with an open fuse provides a clamp on the instrument loop current that will prevent the signal from ever dropping below the current magnitude that the DFWLC system recognizes as a failed signal current. In this specific circuit there are three instrument loops fed from the one fuse. Therefore, when the fuse opened only one or two (depending on the transmitter impedance) of the loop signals could drop below the signal failure limit of 2 mA. This prevented the feedwater flow analog signal error from being reached as required by the design requirements of the DFWLC system.

The inadvertent grounding by the IM technician during testing was a contributing cause to this event. However, inadvertent grounding during testing was considered during the design development and should not have resulted in this event. An inadvertent ground should have resulted in the DFWLC System automatically changing to single-element control, which would have prevented the feedwater transient.

The event investigation had also identified the operator actions as a contributing cause to the reactor scram. Although the operator acted in accordance with procedures and training, analysis of the event showed that different actions available may have mitigated the level transient.

D. SAFETY ANALYSIS

The safety significance of this event was minimal. The operators performed all actions in accordance with the procedures and training. During the vessel level transient a manual scram was inserted by control room personnel at the administrative limit of 44" increasing in accordance with station procedure. The manual scram was inserted in anticipation of the automatic scram on reactor high level due to a turbine trip. All expected ESF actuations occurred as designed to bring the reactor to a safe shutdown condition. Adequate makeup to the vessel was available at all times from the feedwater system, as well as from the ECCS systems. Off-site power was maintained on both Units supplying power to the 4 kV safety busses. The Emergency Diesel Generators (EDG) were available if required. Unit 1 was not affected by the Unit 2 scram.

E. CORRECTIVE ACTIONS

Immediate Actions

The three transmitters affected by the blown fuse were replaced.

The affected Analog Input card for the DFWLC was replaced.

Until final corrective actions are implemented, Single Element control is required for DFWLC-related maintenance.

Corrective Actions to be Completed:

The blown fuse indicator circuit will be removed from the 24 Vdc I/O signal fuse-holders (nine fuse holders for Analog input cards only) so the DFWLC signal error detection function will work properly.

Proper fitting test equipment leads that will interface with the Rosemount transmitter hollow test screws will be investigated and obtained and the equipment will be insulated to minimize the potential of grounding an instrument loop on critical components in critical systems.

The default operator actions for feedwater level transients will be reviewed and any improvements identified will be implemented.

F. PREVIOUS OCCURRENCES

No previous occurrences involving indicating fuse holders during the last five years were identified.

G. COMPONENT FAILURE DATA

The fuse holder is a Phoenix Contact UK5-HESILED 24 model fuse holder.